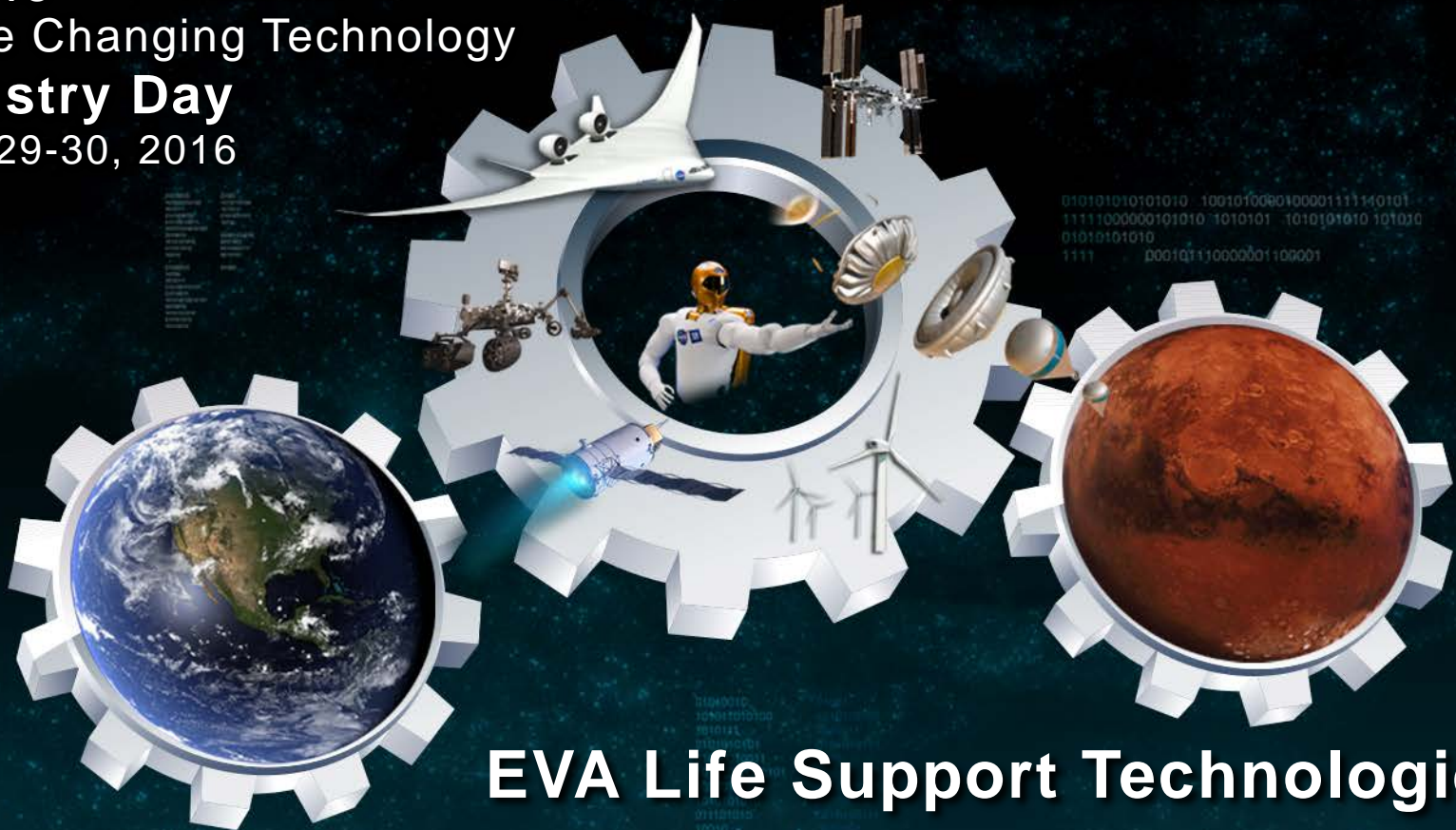




NASA's
Game Changing Technology
Industry Day
June 29-30, 2016



EVA Life Support Technologies

Presented by Daniel Barta
Manager, Next Generation Life Support Project
NASA Johnson Space Center

TECHNOLOGY DRIVES EXPLORATION



EVA Life Support Technologies



The Next Generation Life Support Project developed two technologies for EVA Portable Life Support Systems (PLSS):

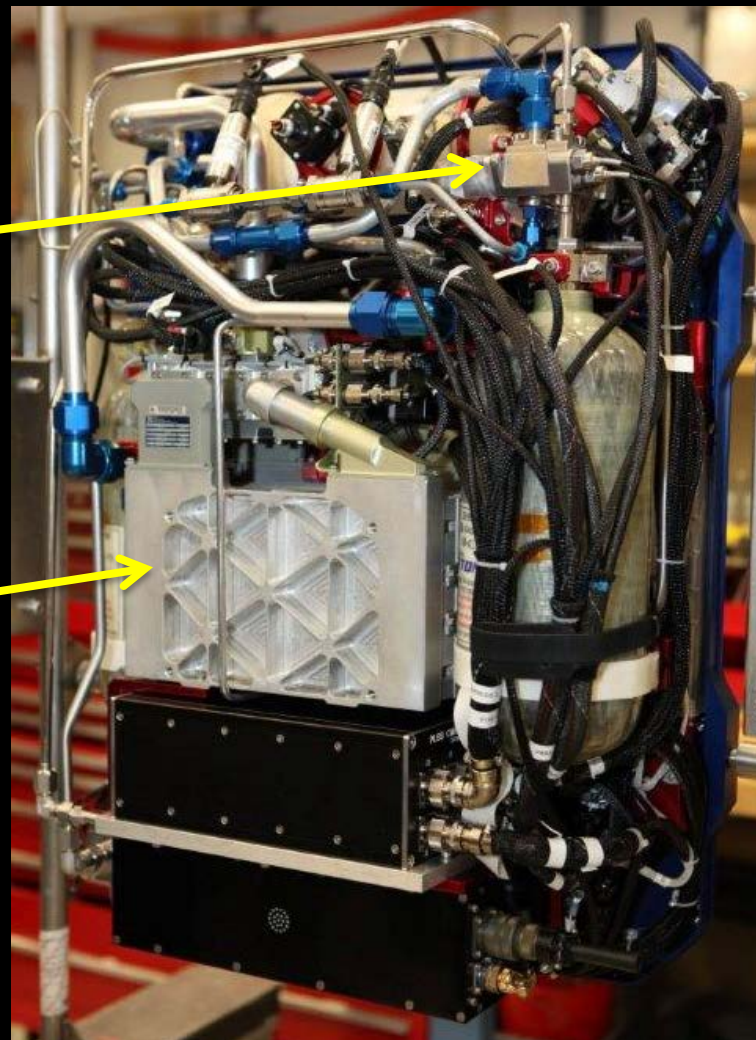
Variable Oxygen Regulator (VOR)

- An oxygen-rated, contaminant-tolerant oxygen regulator to control space suit pressure with an increased number of pressure setpoints as compared to the SOA.

Rapid Cycle Amine (RCA) Swingbed

- Continuously removes CO₂ and H₂O from a flowing ventilation stream through the use of a two-bed amine based, vacuum-swing adsorption system.

Second Generation prototypes (2.0) were integrated into the Portable Life Support Systems (PLSS) 2.0 Test Article and evaluated during a series of integrated tests.



PLSS 2.0 Test Article

Courtesy AES Advanced Space Suit Project



Variable Oxygen Regulator (VOR)



Key Features

- Oxygen-rated
- Contaminant tolerant (50 mg/ft²)
- Combustion tolerant
- Pressure regulation range: 0 – 8.4 psi
- Pressure set points: 4,000
- Nominal pressure source 3000 psi

Status

- Developed over the period October 2012 to April 2015
- Current TRL : 6
- Transitioned to NASA Customer Advanced Space Suit Project, Advanced Exploration Systems



VOR Test Article at White Sands Test Facility (WSTF) for Oxygen Compatibility and Contaminant Testing



Variable Oxygen Regulator (VOR)



Benefits

- Provides continuous control of suit pressure, resulting in higher levels of flexibility & safety for EVA.
- Provides suits to have flexibility to integrate across various future spacecraft & missions, regardless of cabin pressure, including designs with “suit ports”.
- Pre-breath protocols to prevent “the bends” could partly be performed within the suit, decreasing preparation time and allowing for more rapid deployment.
- Designed with safety in mind. It is robust and tolerant of contamination. It will withstand combustion events and retain enough capability after failure to return an astronaut back to the spacecraft safely.



Suitport evaluation during
analog testing at Black Point
Lava Flow, Arizona



Variable Oxygen Regulator (VOR)



Potential uses beyond NASA

- Commercial crew space suits
- Commercial human spacecraft
- Medical and industrial applications that require precision and varied oxygen pressure settings.

Partnerships

- Current partnerships
 - Cobham Life Support, Orchard Park, NY
 - NASA AES Advanced Life Support Project
- Future/potential partnerships
 - Other space suit or space vehicle companies (Boeing, Lockheed Martin, SpaceX, Blue Origin, David Clark Co., ILC Dover, etc.)
- Industry/NASA collaborations could benefit in reduced development costs to bring this technology to commercial markets earlier.
- Next steps: Testing of the VOR in the relevant space environment of suited thermal vacuum conditions.



Suitports on pressurized electric rover during analog testing at Black Point Lava Flow, Arizona



Rapid Cycle Amine (RCA) Swingbed

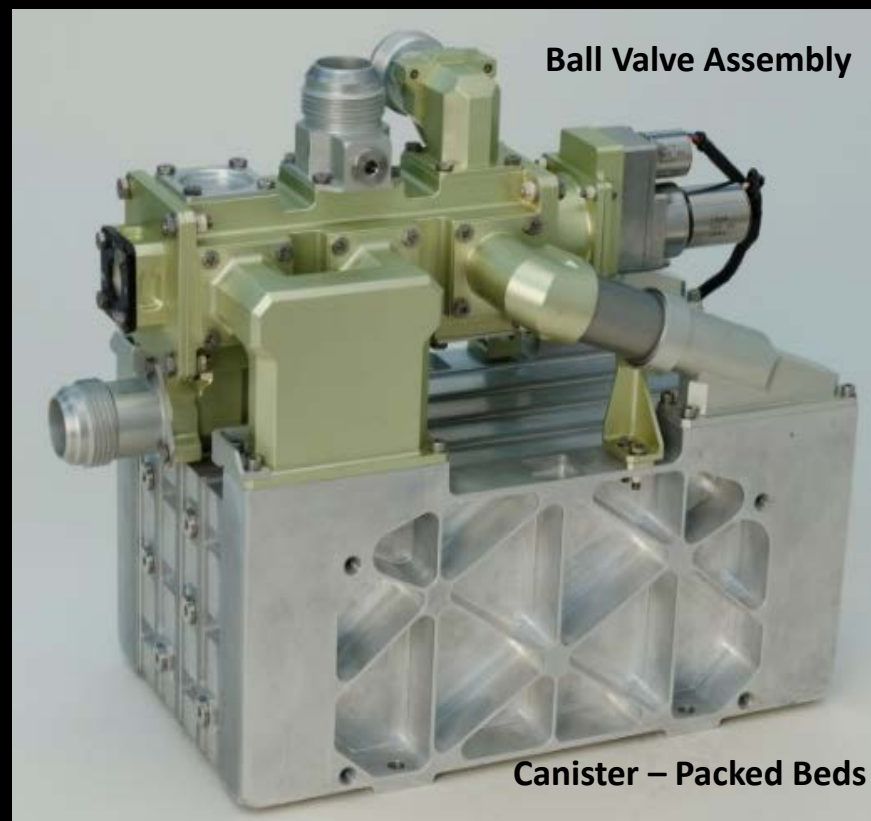


Key Features

- Carbon dioxide removal
- Humidity removal
- Continuous regeneration into space vacuum
- Sizing: 1 crew-member EVA
- Oxygen-Rated

Status

- Developed over the period October 2012 to July 2015
- Current TRL : 5
- Transitioned to NASA Customer Advanced Space Suit Project, Advanced Exploration Systems



Rapid Cycle Amine (RCA) Swingbed
without integrated controller



Rapid Cycle Amine (RCA) Swingbed

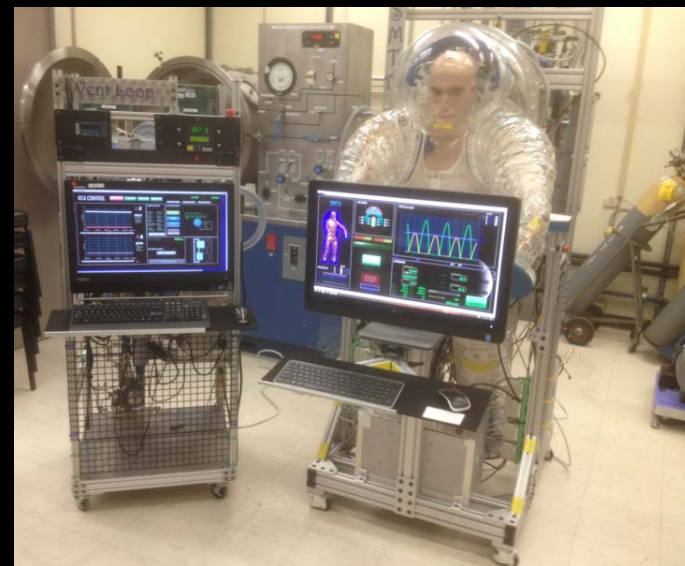


Current Space Suit State-of-the-Art

- One time use lithium hydroxide canisters and regenerable Metal Oxide (METOX) consume significant mass, volume, power and limit the duration of the EVA.
- The thermal loop humidity condenser and spin separator complicate suit design, add mass and are prone to failure.

Benefits

- The RCA Swingbed is a dual function component for the space suit ventilation system, removing both carbon dioxide and humidity
- The system is regenerative. The dual amine beds do not require change out and thus do not limit the duration of EVAs
- The thermal system is greatly simplified, reducing the mass and complexity of the suit, eliminating high maintenance hardware associated with moisture removal.



Suited Manikin Test Apparatus (SMTA) for evaluation of advanced space suit ventilation loop components



Rapid Cycle Amine (RCA) Swingbed



Potential uses beyond NASA

- Commercial crew space suits
- Commercial human spacecraft

Partnerships

- Current partnerships
 - United Technologies Aerospace Systems, Windsor Locks, CT
 - NASA AES Advanced Life Support Project
- Future/potential partnerships
 - Other space suit or space vehicle companies (Boeing, Lockheed Martin, SpaceX, Blue Origin, David Clark Co., ILC Dover, etc.)
- Industry/NASA collaborations could benefit in reduced development costs to bring this technology to commercial markets earlier.
- Next steps: Testing of the RCA Swingbed in the relevant space environment of suited thermal vacuum conditions.



Z-Series Next
Generation Space Suit



Next Generation Life Support Project



NGLS Video

<https://www.youtube.com/watch?v=qVOiwwFbozs>



Contact Information



For more information about the technologies or to discuss potential collaboration efforts:



Daniel Barta
Project Manager
daniel.j.barta@nasa.gov
Office: 281-244-5118
Cell: 832-226-3291



Marlon Cox
VOR Lead Engineer
marlon.r.cox@nasa.gov
Office: 281-483-9274



Cinda Chullen
RCA Lead Engineer
cinda.chullen-1@nasa.gov
Office: 281-483-8384

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